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PLAGUE.

Circular of instructions in regard to plague; prepared by a committee appointed by the Department of Health for the consideration of plague measures—Berlin, September 28, 1899.

[Translated in this Bureau from supplement to the "Veröffentlichungen des Kaiserlichen Gesundheitsamtes." No. 49, 1899.]

When an epidemic invasion is apprehended, it is of the utmost importance to recognize the first case.

The following information is intended to instruct physicians in the symptomatology of plague and thus enable them to care intelligently for the public health :

Clinical symptoms of plague.

In all epidemics it has been found that even skilled physicians fail to recognize the disease, mistaking it for common carbuncle, infection of the lymph glands, typhus, intermittent fever, or anthrax.

The disease attacks persons of all ages and social conditions and both sexes.

The condition of declared illness is preceded by warning symptoms, sometimes of an hour's and sometimes of a day's duration. These are pallor, depression, pains, headache, thirst, loss of appetite. The onset of the disease is frequently sudden, with sharp, burning, or dull pains on the spot on which later the glandular inflammation, or carbuncle, or the pneumonic manifestation appears. This is followed by a sensation of cold, culminating in a severe, shaking chill, succeeded by fever. The fever may last an hour or a day before the local symptoms appear.

The onset of the disease is almost invariably accompanied by a feeling of dizziness in the head. This may increase to a painful roaring, accompanied by indications of great weakness and failing power to control the limbs. Nausea and vomiting frequently accompany this condition, and not infrequently weakness of heart to the point of collapse.

When the patient comes into the physician's hands, the disease is usually well developed. The staring gaze, the bloated, languid, and expressionless face, the injected cornea, the thick, stammering speech, the uncertain gait, give the patient the aspect of a drunken man. This appearance is heightened by the outbreak of bloody boils. The tongue is red and lumpy or else coated with white. The skin is generally hot and burning, especially about the face and trunk, while the pulseless limbs are cold and covered with a slimy sweat.

The breathing is painful and labored, the heart action weak, the arteries are relaxed, the pulse of the radials is dicrotic and approaches extinction, while the heart action is still good.

After taking to his bed the patient lies in a condition of great weakness and tendency to sleep, murmuring softly and disconnectedly, or throws himself about restlessly, talking deliriously, imagining that he must return to his home or his business, or quench his thirst, and he will try to escape if his attendants do not hold him down in bed.

With careful examination in the early stage of the disease the local focus of infection may be found in the majority of cases and the diagnosis made with accuracy. A freshly developed glandular swelling or skin pustule or the inception of an inflammation of the lungs belong to the complete picture of plague infection. The disease presents itself under one of three forms—glandular, skin, or lung plague. Abdominal plague has been verified only in the case of animals.

In glandular or bubonic plague the most frequent form of the disease is characterized by the appearance of a bubo, which, sooner or later and to a greater or less degree, develops into an inflamed swelling and affects the surrounding tissues. Any external lymph gland may be the first seat of the disease. In most cases the bubo appears in the region of the thigh or groin, frequently under the arm, or, especially in children, on the neck. In isolated cases the buboes appear on the back of the head, at the elbow joint, the knee caps, the outer or inner ear glands, the hyoid bone, etc.

The external lymph glands are often found to be in a minor state of inflammation or appear to have escaped the influence of the germ, while the concealed glands have developed buboes of the third or fourth order, so that, for example, the thigh glands may remain free while a large iliac bubo or lumbar bubo may form that may be perceived as a perityphlitic swelling of the abdominal covering; or the neck glands may be only slightly swollen while there are evidences of the formation of a bubo in the upper chest cavity.

The bubo may appear as a separate enlarged gland, or there may be an inflammation of the connective tissue, which is hard-packed and is frequently accompanied by a doughy cedema diffused about it. The bubo is generally not painful in itself, but on pressure, and the patient may lie in a position in which he suffers no pain. A small bubo is often not observed by the patient or his attendants, so that it must be sought for by the physician by pressure of suspected parts.

Plague pustules and plague carbuncles are not frequent as compared with plague buboes. They begin with a spot about the size of a flea bite or a pea on some part of the skin. From this very painful spot there develops a blister filled with cloudy matter. It then either retains the character of a pustule, or the surrounding tissue becomes hard and thick, later developing into a deep carbuncle and then into a burning swelling. Inflamed lymph vessels may convey the infection to the nearest layer of glands, in which then a bubo may grow. A bubo may also make its appearance in the neighborhood of a carbuncle.

Pneumonic plague, which is the prevailing form in some plague epidemics, generally follows the course of an ordinary violent catarrhal or croupous pneumonia. When the general symptoms are very severe there may be difficulty in differentiating it from other inflammations of the lungs without bacteriological examination.

Bubo, plague, pustule, or inflammation of lungs appears at the beginning of the disease, sometimes even before the fever, or develops clearly a few hours or days after. Their appearance is seldom deferred till the third day.

In all forms of plague the early appearance of heart weakness is noted, together with irritation of stomach and abdomen, extreme sensitiveness to pressure in the region of the epigastrium and the cæcum, violent nausea, later, also, the expulsion of black fæcal matter. A slight degree of swelling of the abdomen is the rule; soft swelling of the spleen and traces of nucleo-albumen and serum albumen in the urine, bloody vomit or blood in urine are less frequent. A diphtheritic affection of the tonsils is often found in the early stages. Almost universally there is observed a greater or less degree of irritation of the connective tissue, with which is frequently associated an inflammation of the cornea, which comes on suddenly and may lead to general supuration of the eye. Hæmorrhagic points or streaks in the skin or mucous membrane are much more frequently observed. In the course of the disease buboes develop in the vicinity of the lymph glands and in different parts of the body.

The course of the disease varies, many a case of skin and gland plague proving to be fairly mild and benignant, while pneumonic plague may terminate rapidly in death. In the bubonic form the neck buboes appear to be a condition of the gravest cases, frequently causing death by suffocation. There are also cases in which death occurs before any appearance whatever of localization, before the patient is even made aware, by pain, of his condition. The third, or at most the fourth day, brings a reduction of the fever and very frequently death. If the patient passes the third or fourth day he may remain free from fever and in the end recover, or the fever may come on again and again run its course. On the sixth or ninth day a marked lowering of the temperature and pulse curve almost invariably occurs, so that a prolongation of the disease, even into the second week, may occur, apparently as the result of supplemental infection due to the formation of secondary buboes. The temperature of the body is usually 30 or 40° C., but may be much less. An increase to 41° C. may occur in the beginning or at the exacerbation of the disease. Before death the fall in the temperature of the body corresponds with the decline in strength, or it may fall suddenly. It may also rise and even in the dead body be 42° C. and more.

The progress of the disease as here traced may be diverted by other infections. More frequently the accompanying infections are due to streptococci, staphylococci, pneumococci, or the bacilli of influenza.

Death may occur at any point of the disease. In cases in which recovery occurs the decline of all the symptoms may take place suddenly or by degrees. When not due to suffocation, caused by neck buboes or pneumonia, death is usually caused by a general failure of the circulation.

Recovery occurs in 10 and often in 40 per cent of cases. It follows in bubonic plague on the decline of the fever or the disposal of the bubo—in cases of carbuncle, on the sloughing of the inflamed tissue.

In severe cases recovery is slow. A sudden failure of the heart may

attack a convalescent. Many patients die of septic fever; some, of plague meningitis. Secondary infection of the respiratory passages, favored by want of proper care or unfavorable environment, causes the death of numbers of convalescents. Even after weeks or months many languish and die from prolonged suppuration, progressive degeneration of the organs or impoverishment of the blood. Among the after effects paralysis plays a large part.

Prognosis of the disease is difficult. It may be stated that when the patient is free from fever on the third or sixth day he will probably recover should no complication occur.

The early appearance of the buboes is relatively favorable. Unfavorable symptoms are bloody vomit, bloody urine, petechiae, the formation of boils or carbuncles, and diphtheria of the tonsils. Hiccough is the immediate precursor of death. Recovery from pneumonic plague is rare. Previously existing diseases of the lungs and other internal organs remove almost all hope of recovery. Mortality is extraordinarily great among the consumptive, the syphilitic, and infants.

A second attack of plague is rare. The second attack is generally fatal. The diagnosis of plague during an epidemic is generally rendered easy by the severe and febrile general symptoms, by the formation of local foci in the lymphatic glands, on the skin or in the lungs, by the unconscious condition of the patient, the unsteady gait, the extraordinarily weak pulse, the injection of the eyes, and the white tongue. When no epidemic prevails the disease may present, even in pronounced cases, an assemblage of symptoms resembling those of anthrax, typhus, or pneumonia. The light cases with less severe local and general symptoms, and the gravest cases, in which death occurs before the manifestation of any local product of disease, escape diagnosis unless bacteriological examination is made, on the patient or in necropsy.

Bacteriology of plague.

The evidence of the specific organism is especially important in preventing wrong diagnosis.

The specific organism of plague is a bacillus without voluntary motion which in form and size shows considerable variations according to the conditions of development, the nature of the culture media, etc. It usually appears as a short rod, with rounded ends, and two or three times as long as it is wide. Not infrequently the difference between length and breadth is so slight as scarcely to preserve the rod shape.

The plague bacillus takes aniline coloration well in streaked preparations. The outer portions of the bacillus, and notably the ends, take coloration four times more strongly than the middle (polar staining), a peculiarity which is especially noticeable in careful methylen blue coloration.

The culture of the plague bacillus succeeds well at air temperature and in the usual culture media and culture fluids (agar-agar, solidified blood serum, gelatin, bouillon, etc). When air is excluded the growth ceases. In culture media, containing sugar, the plague bacillus does not produce fermentation with development of gas. Its growth is good at a temperature of 25° to 37° C. Between 10° and 15° C. it is slow, but still strong, and even at 5° C. it is not completely arrested. When the material for planting is taken from a plague patient or a plague cadaver the development, even at a favorable temperature, is slow. On the surface of thick agar, for example, which has been kept at a temperature of 37° C., the beginning of the formation of colonies can be seen

with the naked eye only after the lapse of twenty-four hours, and for full development a period twice or three times as long is required.

Superficial cultures then appear on microscopic examination as transparent, small, drop-shaped colonies which have little tendency to coalesce. Cultivated in bouillon, the plague bacilli grow in chains like streptococci. On very dry agar, to which from 2 to 3 per cent of cooking salt has been added, the plague bacilli grow abundantly in from one to two days in involution forms, being large, ball-shaped or irregularly formed masses, which are deficient in their capacity to take coloration.

Resistant forms of the plague bacillus are not known. In fluid media the bacilli die in ten minutes at a temperature of 55° or 60° C. At the boiling point they are killed immediately. Dried on linen and the like they remain alive in the climate of Europe many weeks.

The plague bacilli are found in all the morbid products of the living patient and generally throughout a plague cadaver. The fluid and tissue of fresh buboes and carbuncles, the exudation of inflamed lungs contain bacilli in enormous quantities. In the contents of the bubo, released either by spontaneous breaking down or by treatment, they are only exceptionally found, so that in cases of bubonic plague ending in recovery they must be obtained by incision of the fresh bubo. Yet these cases occasion error in diagnosis. Blisters and carbuncles readily yield, on puncture, material for bacteriological diagnosis.

In the much more numerous cases of pneumonic plague the sputum, which always contains numerous bacilli, furnishes the most reliable diagnostic material. In the absence of sputum, section or puncture of the lung of a plague cadaver decides the diagnosis, if this decision has not already been arrived at by bacteriological examination of the blood. Examination should not be neglected in any plague case, since it is always easily practiced and is often decisive. In the majority of plague cases which end fatally the bacilli are found, either sparingly or in quantities in drops of blood drawn by a needle prick in the skin, made either during the last hours of life or several days previously. In the normal secretions they are not often found and are more difficult to obtain. They always appear in numbers in terminal lung œdema.

If the bacteriological examination of a patient is for any reason unsatisfactory, it is always easy and reliable in the case of material from plague cadavers. Beside the primary localizations in the skin, lungs, and glands, the blood, spleen, lung hypostasis, gall, cerebro-spinal fluid furnish especially good objects for the identification of the bacillus.

Necropsy undoubtedly demonstrates the fact of plague cases which during life were obscure. Anatomical findings are more uniform, and, therefore, more reliable than clinical symptoms. Beside the primary lesions, *i. e.*, the fatty or warty swellings of the lymph glands, juicy and often bloody permeation into the surrounding tissue, deep infiltration from carbuncular swelling, and lobular or lobar thickening of the lungs, almost every cadaver shows a soft, swollen spleen, shellac-colored blood, and almost always bloody effusions into various organs, especially the stomach, small intestines, and cæcum, the basin of the kidneys, etc.; also here and there foci of necrosis and highly developed parenchymatous degeneration of the intestines, especially the liver.

In the treatment of plague it is of the highest importance to secure a comfortable location, fresh air, and cool lotions. The great thirst from which the patient suffers should be unsparingly gratified. Fresh water, acidulated drinks, and milk are the most acceptable. The use of effervescent drinks is discouraged by many physicians when there is marked depression of the brain or other vital centers.

Cleansing of the digestive organs by means of castor oil, or similar mild medicament, is recommended by many physicians, and appears from necropsic findings to be efficacious. These often show inflamed and packed bowels, with bloody effusions. Physicians are not agreed as to heart stimulants.

Cauterization of the pustules and the application of mercuric or carbolic washes or salves to the buboes or inflamed glands appear advisable. The further treatment of the buboes is surgical. In pneumonic plague the inhalation of a 1 per cent carbolic and lime-water spray is desirable.

The best protection for physicians and attendants is *absolute cleanliness*. The great danger of infection through the sputum of living plague patients and the oedematous exudation from the lungs of the dying are to be especially guarded against.

Disinfection must be applied to all excreta of the patient and to all articles that come in contact with him. For chemical disinfection, solutions of sublimate (1-1000) carbolic solution (3 per cent) cresol soap and chloride of lime solutions are especially to be recommended.

As a prophylactic agent, for the protection of physicians and attendants may be mentioned inoculation with dead plague culture, which constitutes the so-called active immunizing process. This plague protective inoculation has been shown, by extensive use in India, to be harmless and to confer protection against infection which if not absolute is yet unmistakable. As far as animal experimentation shows, the inoculation loses its protective power after seven days.

* * * * *

Epidemiology.—It has been demonstrated that plague spreads slowly after its introduction. In many instances it has been found to be confined to the family in which the first case occurred and to persons who have come in contact with the plague patient. It will then make its appearance in neighboring houses or in a distant quarter to which it has been conveyed by persons who have been in contact with the plague patient. In this manner the disease fixes itself when it has found a favorable soil and remains unnoticed during weeks and months, when it often develops quite rapidly and reaches its maximum at first by quick and then by slow degrees. Its extinction is often only apparent. After a period of suspension lasting weeks or months a fresh epidemic not infrequently begins and this may also have still further developments.

Epidemics of sudden development, such as Asiatic cholera and abdominal typhus, which result from the long persistence of the germ in drinking water and water for domestic uses, are not observed in plague.

An important feature in the conditions affecting plague is the disposition of the disease to confine itself to separate dwellings and to discriminate among the persons resident there. When the persons affected are removed from the house further infection may by care be prevented.

In the propagation of plague the transference of the germ from man to man is in the first line of importance. This transference may occur directly or by means of contact with articles of clothing and laundry, or in general any articles of use.

The manner in which the cause of disease leaves the body has already been shown. The danger of infection is generally slight in mild cases of the disease where the plague germ is confined to the swollen gland. The conditions are scarcely altered when the bubo becomes soft or breaks down, since in that case the plague bacillus is, as a rule, already dead. The facility of infection is much greater in severe types of septicæmic

cases of bubonic plague, in which the disease germ may be discharged, living, with the several secretions of the body, or found in quantities shortly before death in pulmonary oedema. The most dangerous cases are of pneumonic plague on account of the quantities of the bacilli which may be contained in the sputum and which are thrown into the air by coughing, or even in the act of speaking.

The plague germ is received into the lymphatic system of a healthy organism by small unobserved injuries to the epidermis, slight scratches, flea-bites, and the like. In other cases it may be taken in by way of the mucous of the mouth or throat, the conjunctival sack, or the nostrils, or may be taken into the bronchial tubes by way of the respiratory passages.

That these various means of infection from man to man constitute an open door for transmission when an unclean people live in close, dark, and crowded houses is apparent. Where light and air are freely admitted and cleanliness prevails plague finds no soil for an epidemic spread.

Direct or indirect transmission of infection from man to man is not the only means of the spread of plague. Many circumstances in the outbreak and spread of this disease are explained by the fact that animals living in the vicinity of men are attacked by fatal epidemics. *Of these animals rats are the most important, they being in the highest degree susceptible to infection by the abdominal canal. As they have the habit of gnawing their sick or dead fellows, plague is easily spread among them when it has once broken out.*

Plague-infected rats are dangerous not only to their own kind. Their excreta, which contain great numbers of plague bacilli, may easily infect human dwellings, as plague-infected rats generally lose their fear of man and not infrequently die in houses. Mice may play a similar part, if not one as apparent or pronounced.

Subterranean and entirely uncontrollable conditions explain to some extent the apparently spontaneous outbreak of plague, together with its disposition to fix itself in crowded quarters and to persist even after a period of cessation.

If the foregoing considerations meet the demand for an understanding of the nature and propagation of plague, their object will have been obtained. They may be especially useful in demonstrating the first cases of a plague outbreak. It need not be added that the final diagnosis of a plague case should be made only with corroborative statement of medical authorities and on the ground of reliable bacteriological examination.

[Reports to the Surgeon-General United States Marine-Hospital Service.]

Report from San Francisco.

SAN FRANCISCO, CAL., April 10, 1900.

SIR: All proceedings in Chinatown discontinued except ordinary inspections. No suspicious cases. * * *

GASSAWAY,
Surgeon, U. S. M. H. S.